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(71) Applicant: *(for all contract states except US)* MERCK PATENT GMBH [DE/DE]; Frankfurter Strasse 250, D-64293 Darmstadt (DE).

(72) Inventors; and
(75) Inventors/applicants *(only for US)*: BUCHHOLZ, Herwig [DE/DE]; Auf dem Mühlberg 75, D-60599 Frankfurt (DE). ROSSKOPF, Ralf [DE/DE]; Friedhofstrasse 26, D-64839 Münster (DE), LICHTENBERG, Alice [DE/DE]; Wilhelminenstrasse 50, D-64285 Darmstadt (DE). KRAUS, Christine [DE/DE]; Bahnhofstrasse 51, D-01987 Schwarzheide (DE).
(74) Joint agent: MERCK PATENT GMBH; Frankfurter Strasse 250, D-64293 Darmstadt (DE).

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(54) **Title:** METHOD FOR PRODUCING LUTEOLIN AND LUTEOLIN DERIVATIVES

(57) **Abstract**
Disclosed is a method for producing compounds of formula (I), wherein R^1 represents H or $(CH_2)_mOH$, R^2 represents H or $(CH_2)_nOH$, R^3 represents H or $(CH_2)_pOH$ and m, n and p represent 2-8 independently from one another. Said compounds are particularly suitable for use as food supplements. They are highly suitable for use in cosmetic formulations as UV filters, for instance.

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Method for producing luteolin and luteolin derivatives

The invention involves a method for producing compounds of formula (I)

[formula I]

in which R^1 represents H or $(CH_2)_mOH$, R^2 represents H or $(CH_2)_nOH$, R^3 represents H or $(CH_2)_pOH$ and m, n and p represent 2 to 8 independently from one another.

The compound of formula (I), in which R^1, R^2 and R^3 are H, is luteolin. In the scope of the invention in question the compounds of formula (I) in which at least one of the groups R^1, R^2 or R^3 has a representation other than H, are designated as luteolin derivatives.

Luteolin possesses various advantageous properties. Luteolin is an excellent antioxidant and a very good radical trap. Moreover, it inhibits enzymatic, nonenzymatic and CCl_4-induced lipid peroxidations. Luteolin exerts a favorable influence on the cardiovascular system and can prevent the development of arteriosclerosis. The anticarcinogenic action of luteolin is evident, for example, in its strong antiproliferative activity against various human tumor cell lines. The anti-inflammatory, antiviral, antibacterial and radioprotective properties of luteolin have likewise been reported. As an inhibitor of the enzyme aldehyde reductase, luteolin can also have a preventive action against the development of diabetic cataracts.

The luteolin derivatives of formula (I) have advantageous properties similar to those of luteolin itself.

Known methods for producing the compounds of formula (I) have the drawback, e.g., of comprising several synthesis stages and/or producing unsatisfactory product yields. For example, until now luteolin could be isolated only from plants or produced via multistage syntheses. The synthesis from suitable chalcones and hesperidin succeeds merely with unsatisfactory yields [U. Achterrath-Tuckermann et al., Planta Med. 39 (1980) 38; D. Nagarathnam et al., J Org. Chem. 56 (1991) 4884; Y.-H. Lu et al., Yao Hsueh Pao 15 (1980) 477; G. Litkei et al., Liebigs Ann. 9 (1995) 1711; Y. Xing et al., Zhongguo Yiyao Congye Zazhi 25 (1984) 481].

There was thus the purpose of developing a method for producing the compounds of formula (I) which avoids or at least reduces the drawbacks of known methods, especially making possible a one-stage production of the compounds of formula (I) from readily available precursors and/or making possible the production of the compounds of formula (I) in higher yield.

Surprisingly, it has now been found that this purpose is realized if the method for producing the compounds of formula (I)

[formula I]

in which R^1 represents H or $(CH_2)_mOH$, R^2 represents H or $(CH_2)_nOH$, R^3 represents H or $(CH_2)_pOH$ and m, n and p represent 2 to 8 independently from one another, is carried out so that compounds of formula (II)

[formula II]

in which R^1, R^2 and R^3 independently from one another have the representation indicated in formula (I), and R represents

[formula] or [formula]

are reduced in aqueous alkaline environment with sodium dithionite $Na_2S_2O_4$.

The invention thus involves a method for producing compounds of formula (I)

[formula I]

in which R^1 represents H or $(CH_2)_mOH$, R^2 represents H or $(CH_2)_nOH$, R^3 represents H or $(CH_2)_pOH$ and m, n and p represent 2 to 8 independently from one another, characterized in that compounds of formula (II)

[formula II]

in which R^1, R^2 and R^3 independently from one another have the representation indicated in formula (I), and R represents

[formula] or [formula]

are reduced in aqueous alkaline environment with sodium dithionite $Na_2S_2O_4$.

The method in accordance with the invention is especially distinguished in that the compounds of formula (I) are produced in a simple manner and/or in higher yields than was possible according to previously known methods.

The invention in question further involves foodstuffs which have been enriched with one or more compounds of formula (I), and also the use of the compounds of formula (I) as food supplements.

The foodstuffs, which, according to the invention in question, can be enriched with one or more compounds of formula (I), comprise all materials suitable for consumption by animals or humans, for example vitamins and provitamins thereof, fats, minerals or amino acids. Examples of foodstuffs which, according to the invention in question, can be enriched with one or more compounds of formula (I) are also foodstuffs that originate from a single natural source, such as, e.g., sugar, unsweetened juice, nectar or purée of a single plant species, such as, e.g., unsweetened apple juice (e.g., also a mixture of various types of apple juice), grapefruit juice, orange juice, apple compote, apricot nectar, tomato juice, tomato sauce, tomato purée etc.

Additional examples of foodstuffs which, according to the invention in question, can be enriched with one or more compounds of formula (I) are grain or cereal of a single plant species and materials produced from such plant species, such as, e.g., cereal syrup, rye flour, wheat flour or oat bran. Mixtures of such foodstuffs are also suitable of being enriched according to the invention in question with one or more compounds of formula (I), for example multivitamin preparations, mineral mixtures or sweetened juice. Additional examples of foodstuffs which, according to the invention in question, can be enriched with one or more compounds of formula (I) are processed foods, for example processed cereals, baked goods, mixed beverages, foods processed especially for children such as yogurt, diet foods, low-calorie foods or animal feed.

The foodstuffs which, according to the invention in question, can be enriched with one or more compounds of formula (I) thus comprise all edible combinations of carbohydrates, lipids, proteins, inorganic elements, trace elements, vitamins, water and active metabolites of plants and animals.

Like the food supplements which contain one or more compounds of formula (I), the foodstuffs which, according to the invention in question, can be enriched with one or more compounds of formula (I) are preferably used orally, e.g., in the form of food, pills, tablets, capsules, powders, syrups, solutions or suspensions.

The foodstuffs in accordance with the invention, enriched with one or more compounds of formula (I), can be produced via techniques familiar to the specialist.

The invention further involves cosmetic or pharmaceutical formulations which contain one or more compounds of formula (I), and also the use of one or more compounds of formula (I) in cosmetic or pharmaceutical formulations. The cosmetic formulations which contain one or more compounds of formula (I), and also the use of one or more compounds of formula (I) in cosmetic formulations, are preferred.

Whereas about 30 years ago sunlight was regarded as therapeutic and innocuous due to vitamin D synthesis, in recent years the attitude toward this relationship has changed considerably, and not only from a medical viewpoint. The potential risk involved with both natural and artificial irradiation with sunlight has moved to the forefront of public awareness. In particular, knowledge about the influence of sunlight on skin aging and the development of skin cancer has also brought about a behavior modification.

As is well known, the skin reacts sensitively to solar rays, which can cause a typical sunburn or an erythema, but also more or less pronounced burns.

However, solar rays also have other negative effects: they cause the skin to lose its elasticity and become wrinkled, resulting in premature aging. Sometimes one can also observe dermatoses, and in the extreme case skin cancer occurs.

It is also desirable to protect the hair against photochemical damage in order to prevent changes in hair color, bleaching or damage of a mechanical nature.

As is well known, the most dangerous part of solar rays comes from the ultraviolet rays having a wave length below 400 nm. It is also known that because of the presence of the ozone layer of the earth's atmosphere, which absorbs part of solar radiation, the lower limit of ultraviolet rays which reach the earth's surface is about 280 nm.

Therefore, the main goal of the field of protection from the sun is actually to ensure a good protection against UVB and UVA radiation.

The compounds of formula (I) can be included alone or naturally also in combination with additional light protection filters of variable substance classes, alone or in combination, in the cosmetic or pharmaceutical preparation. Examples of light protection filters of other substance classes are organic or inorganic UVA and UVB filters, IR or VIS filters. The combination with organic UV filters or mixtures thereof is especially preferred.

Therefore, a subject of the invention is also the use of one or more compounds of formula (I) in cosmetic formulations such as sun protectants, skin creams or gels, hair gels or cosmetic pencils, especially as UV filters.

All UVA and also UVB filters familiar to the specialist can be considered as additional suitable organic UV filters. For both UV ranges there are many known and proven substances from the specialist literature, e.g.,

benzylidenecamphor derivatives such as

- 3-(4'-methylbenzylidene)-dl-camphor (e.g., Eusolex® 6300),
- 3-benzylidenecamphor (e.g., Mexoryl® SD),
- polymers of N-{(2 and 4)-[(2-oxoborn-3-ylidene)methyl]benzyl}-acrylamide (e.g., Mexoryl® SW),
- N,N-trimethyl-4-(2-oxoborn-3-ylidenemethyl)anilinomethyl sulfate (e.g., Mexoryl® SK) or
- α-(2-oxoborn-3-ylidene)toluene-4-sulfonic acid (e.g., Mexoryl® SL),

benzoyl methanes or dibenzoyl methanes such as

- 1-(4-tert-butylphenyl)-3-(4-methoxyphenyl)-1,3-propanedione (e.g., Eusolex® 9020) or
- 4-isopropyldibenzoyl methane (e.g., Eusolex® 8020),

benzophenones such as

- 2-hydroxy-4-methoxybenzophenone (e.g., Eusolex® 4360) or
- 2-hydroxy-4-methoxybenzophenone-5-sulfonic acid and its sodium salt (e.g., Uvinul® MS-40),

esters of methoxycinnamic acid such as

- octyl methoxycinnamate (e.g., Eusolex® 2292),
- 4-isopentyl methoxycinnamate, e.g., as a mixture of the isomers (e.g., Neo Heliopan® E 1000),

salicylate derivatives such as

- 2-ethylhexyl salicylate (e.g., Eusolex® OS)
- 4-isopropylbenzyl salicylate (e.g., Megasol®) or
- 3,3,5-trimethylcyclohexyl salicylate (e.g., Eusolex® HMS),

4-aminobenzoic acid and derivatives such as

- 4-aminobenzoic acid,
- 2-ethylhexyl 4-(dimethylamino)benzoate (e.g., Eusolex® 6007),
- ethoxylated ethyl 4-aminobenzoate (e.g., Uvinul® P25),

and additional substances such as

- 2-ethylhexyl 2-cyano-3,3-diphenyl acrylate (e.g., Eusolex® OCR),
- 2-phenylbenzimidazole-5-sulfonic acid and also its potassium, sodium and triethanolamine salts (e.g., Eusolex® 232),
- 3,3'-(1,4-phenylenedimethylene)-bis-(7,7-dimethyl-2-oxobicyclo-[2,2,1]hept-1-ylmethane sulfonic acid and also its salts (e.g., Mexoryl® SX) and
- 2,4,6-trianilino-(p-carbo-2'-ethylhexyl-1'-oxi)-1,3,5-triazine (e.g., Uvinul® I 150).

These organic UV filters are as a rule incorporated into cosmetic formulations in an amount from 0.5 to 10 percent by weight, preferably 1-8%.

Examples of additional suitable organic UV filters are

- 2-(2H-benzotriazol-2-yl)-4-methyl-6-(2-methyl-3-(1,3,3,3-tetramethyl-1-(trimethylsilyloxy)disiloxanyl)propyl)phenol (e.g., Silatrizole®),

- 4,4'-[(6-[4-((1,1-dimethylethyl)aminocarbonyl)phenylamino]-1,3,5-triazine-2,4-diyl)diimino]bis(2-ethylhexyl benzoate) (e.g., Uvasorb® HEB),
- α-(trimethylsilyl)-ω-[trimethylsilyl]oxy]poly[oxy(dimethyl [and about 6% methyl[2-[p-[2,2-bis(ethoxycarbonyl)vinyl]phenoxy]-1-methylene ethyl] and about 1.5% methyl[3-[p-[2,2-bis(ethoxycarbonyl)vinyl]phenoxy]-propenyl] and 0.1 to 0.4% (methyl hydrogen)silylene]] ($n \approx 60$) (e.g., Parsol® SLX),
- 2,2'-methylene-bis-(6-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)phenol) (e.g., Tinosorb® M),
- 2,2'-(1,4-phenylene)bis-(1H-benzimidazole-4,6-disulfonic acid, monosodium salt) (e.g., Neo Heliopan® AP) and
- 2,4-bis-{[4-(2-ethyl-hexyloxy)-2-hydroxyl]-phenyl}-6-(4-methoxyphenyl)-1,3,5-triazine (e.g., Tinosorb® S).

These organic UV filters are as a rule incorporated into cosmetic formulations in an amount from 0.5 to 20 percent by weight, preferably 1-15%.

Conceivable inorganic UV filters are those from the group of titanium dioxides such as, e.g., coated titanium dioxide (e.g., Eusolex® T-2000), zinc oxides (e.g., Sachtotec®), iron oxides or also cerium oxides. These inorganic UV filters are a rule incorporated into cosmetic formulations in an amount from 0.5 to 20 percent by weight, preferably 2-10%.

In the formulations containing compounds of formula (I) together with other UV filters, the compounds of formula (I) act, e.g., as antioxidants and radical traps. Moreover, a broad-band

UV protection is achieved with such formulations. A subject of the invention is thus also the use of one or more compounds of formula (I) in cosmetic or pharmaceutical formulations as UV filter, antioxidant and/or radical trap.

A further subject of the invention is a method to protect the skin and/or natural or sensitized hair from solar radiation, a cosmetic preparation containing one or more compounds of formula (I) being applied to the skin or the hair as a light protection filter.

The sun protectants in accordance with the invention can optionally also contain one or more chemical substances with self-tanning properties.

All natural and synthetic substances which are suitable for producing cosmetic formulations and are familiar to the specialist can be used as chemical substances with self-tanning properties. Such substances can be both plant extracts and synthetic self-tanning agents, such as, e.g., dihydroxyacetone or α-ketols.

In addition, the formulation in accordance with the invention can also be used for preventive treatment of inflammations and allergies of the skin and also in certain cases to protect against certain types of cancer.

The preparation in accordance with the invention is used as an agent to protect the human epidermis or the hair or also sensitized hair or as sun protectant.

"Sensitized hair" is defined as hair which has been subjected to a permanent wave treatment or a dyeing or bleaching process.

The cosmetic preparation in accordance with the invention is used to protect human epidermis against solar irradiation. For this purpose it exists in various forms that are typically used for this type of preparation. In particular, it can thus exist as a lotion or emulsion, such as a cream or milk (O/W, W/O), in the form of oily-alcoholic, oily-aqueous or aqueous-alcoholic gels or as solid pencils or be formulated as an aerosol.

The formulation can contain cosmetic adjuvants typically used in these types of preparations, such as, e.g., thickeners, softeners, moisturizers, surfactants, emulsifiers, preservatives, antifoaming agents, perfumes, waxes, lanolin, propellants, dyes and/or pigments which dye the agent itself or the skin, and other ingredients normally used in cosmetics.

As dispersant or solubilizer one can use an oil, wax or other fatty substance, a low monoalcohol or a low polyol or mixtures thereof. The especially preferred monoalcohols or polyols are ethanol, i-propanol, propylene glycol, glycerin and sorbitol.

One preferred embodiment of the invention is an emulsion which exists as a protecting cream or milk and comprises, in addition to one or more of the compounds of formula (I) as UV filter—and optionally yet other light protecting filters—fatty alcohols, fatty acids, fatty acid esters, especially triglycerides and fatty acids, lanolin, natural or synthetic oils or waxes and emulsifiers in the presence of water.

Additional preferred embodiments are oily lotions based on natural or synthetic oils and waxes, lanolin, fatty acid esters, especially triglycerides of fatty acids, or oily-alcoholic lotions

based on a low alcohol such as ethanol, or on a glycol such as propylene glycol, and/or on a polyol such a glycerin, and oils, waxes and fatty acid esters such as triglycerides of fatty acids.

The cosmetic preparation in accordance with the invention can also exist as an alcoholic gel comprising one or more low alcohols or polyols such as ethanol, propylene glycol or glycerin, and a thickener such as diatomaceous earth. In addition, the oily-alcoholic gels contain natural or synthetic oil or wax.

The solid pencils consist of natural or synthetic waxes and oils, fatty alcohols, fatty acids, fatty acid esters, lanolin and other fatty substances.

If a preparation is formulated as an aerosol, as a rule one uses the conventional propellants such as alkanes, fluoroalkanes and chlorofluoroalkanes.

If the agent in accordance with the invention is intended to protect natural or sensitized hair from solar irradiation, it can thus exist as a shampoo, lotion, gel or emulsion for rinsing, the formulation in question being applied before or after the shampooing, before or after the dyeing or bleaching, before or after the permanent wave; or the agent exists as a lotion or gel for styling or treating, as a lotion or gel for brushing or setting a water wave, as hair lacquer, permanent wave agent, dyeing or bleaching agent of the hair. This agent can contain, in addition to one or more of the compounds of formula (I) as organic UV filter—and optionally additional light protecting filters—various adjuvants used in this type of agent, such as surfactants, thickeners, polymers, softeners, preservatives, foam stabilizers, electrolytes,

organic solvents, silicone derivatives, oils, waxes, degreasers, dyes and/or pigments which dye the agent itself or the hair, or other ingredients typically used in hair care.

The cosmetic preparations in accordance with the invention can be produced via techniques familiar to the specialist.

Among the compounds of formula (I), the compound in which R^1, R^2 and R^3 represent H, and the compounds in which R^1 represents $(CH_2)_mOH$, R^2 represents $(CH_2)_nOH$, R^3 represents $(CH_2)_pOH$ and m, n and p represent 2 to 8 independently from one another, are preferred. These compounds of formula (I) are designated above and hereafter also as compounds of formula (I*)

[formula I*]

in which m*, n* and p* represent 2 to 8 independently from one another. The compounds of formula (I*) are especially preferred.

The invention in question also involves these compounds of formula (I*).

In the compounds of formula (I) or I*, m, n and p or m*, n* and p* are independently from one another 2, 3, 4, 5, 6, 7 or 8. m, n and p or m*, n* and p* are preferably independently from one another 2, 3 or 4. m, n and p or m*, n* and p* are especially preferably equal; m, n and p or m*, n* and p* very exceptionally preferably represent 2.

The compounds of formula (I*) have a better water solubility than luteolin itself. Moreover, it was surprisingly found that the compounds of formula (I*) are colorless. Foodstuffs in

accordance with the invention which are enriched with one or more compounds of formula (I*), and also cosmetic formulations in accordance with the invention containing one or more compounds of formula (I*), are especially preferred. Consequently, the use of one or more compounds of formula (I*) as a food supplement or its use in cosmetic formulations, e.g., as UV filter, is also especially preferred.

The invention in question makes available an advantageous method for producing the compounds of formula (I) via reduction of the compounds of formula (II). In this method either rutin or its derivatives alone, isoquercetin or its derivatives alone or also mixtures thereof, such as, e.g., a mixture of rutin and isoquercetin or a mixture of rutin derivatives and isoquercetin derivatives, are used as educts in the reaction.

According to the method in accordance with the invention, the compounds of formula (II) are dissolved or suspended in water, preferably in boiling water, and are added to sodium dithionite $Na_2S_2O_4$ after an alkaline pH has been set, e.g., using alkali or alkaline-earth hydroxides or carbonates such as sodium hydroxide solution or sodium carbonate. The reaction mixture is subsequently stirred until the reaction ends, preferably under reflux.

The compounds of formula (II) are commercial obtainable or can be obtained or produced according to methods familiar to the specialist and described in the literature (e.g., in standard publications such as Houben-Weyl, Methoden der organischen Chemie [Methods of Organic Chemistry], Georg-Thieme-Verlag, Stuttgart).

Suitable reaction temperatures for the method in accordance with the invention are temperatures between 25 and 100° C. The method in accordance with the invention is preferably carried out at reaction temperatures from 50 to 100° C, especially at reaction temperatures from 80 to 100° C.

Suitable pH values for the method in accordance with the invention are pH values between 7.5 and 11. The method in accordance with the invention is preferably carried out at pH values from 8 to 9, especially at pH values from 8.2 to 8.7.

Examples of suitable bases for the method in accordance with the invention are alkali or alkaline-earth metal hydroxides, hydrogen carbonates or carbonates. Preferred bases are selected from NaOH, KOH, $NaHCO_3$, $KHCO_3$, Na_2CO_3, K_2CO_3. The method in accordance with the invention is especially preferably carried out with the use of bases selected from NaOH and Na_2CO_3.

Suitable weight ratios of the compound of formula (II) : water for the method in accordance with the invention are ratios from 1:10 to 1:200. The method in accordance with the invention is preferably carried out at weight ratios of the compound of formula (II) : water from 1:50 to 1:150, especially at weight ratios from 1:80 to 1:120.

Suitable weight ratios of the compound of formula (II) : sodium dithionite $Na_2S_2O_4$ for the method in accordance with the invention are ratios from 1:1 to 1:100. The method in accordance with the invention is preferably carried out at weight ratios of the compound of

formula (II) : sodium dithionite $Na_2S_2O_4$ from 1:5 to 1:40, especially at weight ratios from 1:8 to 1:25.

The method in accordance with the invention is preferably carried out under atmospheric pressure.

The reaction can proceed and/or end and the reaction products can be analyzed, e.g., via HPLC, e.g., with the use of standard HPLC instruments and columns containing reversed-phase materials with C_{18} alkyl charging.

Alternatively, the progress and/or the end of the reaction can also be controlled via thin-layer chromatography (TLC).

After the reaction has ended, the reduction product is isolated according to current methods. "Usual working-up" is defined in the scope of the invention in question as follows:

The reaction mixture is cooled, for example to a temperature of 5° C and subsequently neutralized via addition of an acid such as, e.g., hydrochloric acid. The reaction mixture is preferably stirred again after the acid is added, for example for 1 to 12 h at a temperature of 0 or 5° C. The crude product that crystallizes out is separated from the rest of the reaction mixture, for example via mechanical methods such as siphoning or filtration. The purity of the crude product is typically > 96%.

For the further purification, completely desalinated water, for example, can be added, stirred under reflux for some time and then hot-filtered, e.g., at a temperature of 85° C. The purity of

the product thus obtained is typically > 99%. However, purities > 99.5% can also be obtained without further steps.

The solid is subsequently dried, e.g., for 12 h at a pressure of 200 mbar and a temperature of 50° C.

Even without further exemplification it is assumed that a specialist can utilize the above description in its broadest scope. For this reason, the preferred embodiments should be understood as a descriptive disclosure and by no means as limiting in any manner whatsoever.

Cited references to all abovementioned and undermentioned applications and publications are completely disclosed in this application.

The following examples are intended to elucidate the invention in question. However, they should by no means be regarded as limiting.

Examples

The referenced sources for the substances used are as follows:

rutin: Merck KGaA, article no. 500017

trihydroxyethylrutin: Merck KGaA, article no. 501902

The reaction is controlled and the reaction products analyzed via HPLC.

HPLC conditions for use of standard HPLC:

column:	LiChroSorb® RP18 (reversed-phase material with C_{18} alkyl charging and a particle size of 5 µm (Merck KGaA, article no. 151355),	
eluent:	mixture of acetonitrile and water in the volume ratio 20:80 (pH 2.6)	
flow:	1 ml/min,	
wavelength:	260 nm,	
temperature:	30° C,	
sample volume:	10 µl,	
sample preparation:	Dissolve 5 mg of sample in 3 ml methanol and top off with the eluent to 10 ml,	
reaction times:	rutin:	7.3 min,
	luteolin:	46.4 min,
	trihydroxyethylrutin:	10.6 min,
	trihydroxyethylluteolin:	43.3 min.

Example 1: Production of luteolin

60 g rutin are suspended in 6 l completely desalinated water and first added to 210 ml 32% aqueous sodium hydroxide solution at 100° C and then to 600 g sodium dithionite. The suspension is subsequently heated for an additional 12 h under reflux stirring, cooled to 5° C, slowly neutralized with 195 ml fuming hydrochloric acid and stirred for 1 h at 0° C. After the

usual working-up 23.3 g crude luteolin having a purity of 96.5% are obtained. After further purification and drying 20.9 g luteolin having a purity of 99.6% are obtained.

Example 2: Production of tri(hydroxyethyl)luteolin

5 g tri(hydroxyethyl)rutin are dissolved in 500 ml completely desalinated water and are first added to 42.5 g sodium carbonate at 100° C and then to 100 g sodium dithionite. The solution is heated for one more hour under reflux stirring, then cooled to room temperature and stirred for another 72 h. 65 ml fuming hydrochloric acid are subsequently added at 5° C and stirred for another 12 h. After the usual working-up 1.95 g tri(hydroxyethyl)luteolin having a purity of 98% are obtained.

Example 3: Production of luteolin

3.5 g isoquercetin are carefully suspended in 500 ml completely desalinated water at 60° C, and 8.8 ml 32% aqueous sodium hydroxide solution are charged to the resulting yellow suspension. The result is a dark-red-colored clear solution. 25 g sodium dithionite are added at 60° C and stirred at this temperature for 12 h. The solution is subsequently cooled to 5° C and carefully neutralized with 37% hydrochloric acid, whereupon the solution immediately becomes turbid. It is stirred for 1 h at 0° C. After the usual working-up 2.05 g luteolin having a purity of 98.8% are obtained.

Claims

1. Method for producing compounds of formula (I)

[formula I]

in which

R^1 represents H or $(CH_2)_mOH$,

R^2 represents H or $(CH_2)_nOH$,

R^3 represents H or $(CH_2)_pOH$ and

m, n and p represent 2 to 8 independently from one another,

characterized in that the compounds of formula (II)

[formula II]

in which R^1, R^2 and R^3 independently from one another have the representation indicated in formula (I), and R represents

[formula]

or

[formula]

are reduced in aqueous alkaline environment with sodium dithionite $Na_2S_2O_4$.

2. Method according to Claim 1, characterized in that a mixture of rutin and isoquercetin or a mixture of rutin derivatives and isoquercetin derivatives is charged to the reaction as educt.

3. Method according to one of the Claims 1 or 2, characterized in that the reaction is carried out at a reaction temperature from 25 to 100° C.

4. Method according to one of the Claims 1 to 3, characterized in that the reaction is carried out at a pH from 7.5 to 11.

5. Method according to one of the Claims 1 to 4, characterized in that the bases are selected from alkali or alkaline-earth metal hydroxides, hydrogen carbonates or carbonates.

6. Foodstuff, characterized in that it has been enriched with one or more compounds of formula (I) from Claim 1.

7. Use of one or more compounds of formula (I) from Claim 1 as food supplement.

8. Cosmetic or pharmaceutical formulation, characterized in that it contains one or more compounds of formula (I) from Claim 1.

9. Formulation according to Claim 8, characterized in that it contains additional UV filters.

10. Use of one or more compounds of formula (I) from Claim 1 in cosmetic or pharmaceutical formulations.

11. Use of one or more compounds of formula (I) according to Claim 10 as UV filter, antioxidant and/or radical trap.

12. Compounds of formula (I*)

[formula I*]

in which

m*, n* and p* represent 2 to 8 independently from one another.